MEMORANDUM

TO: Ron St. John

FROM: Hank Mittelhauser

DATE: July 9, 2003

SUBJECT: Determination of the Locations for Residential Ambient Air Sampling

1.0 INTRODUCTION

The USEPA is requiring Lockformer to perform ambient air monitoring in residential neighborhoods near the Lisle facility. The purpose of the ambient air monitoring is to ensure that emissions from the stack associated with the remediation system, or from the plenum over the ERH remediation area, do not result in exceedence of allowable ambient air standards. USEPA has provided allowable ambient air standards for chemicals that could potentially be liberated to the atmosphere during remediation activity. In order to determine the ambient air concentrations, Lockformer has agreed to conduct ambient air monitoring, using Summa canisters to collect air samples, on a schedule approved by the USEPA.

USEPA has requested that Lockformer place the Summa canisters at the location of the expected maximum ambient air organic concentrations resulting from stack emissions associated with the remediation system. Lockformer is also performing monitoring around the perimeter of the ERH remediation area to ensure that any possible breaches of the plenum are detected and corrective action is implemented.

USEPA has requested that Lockformer use the SCREEN 3 model to predict the location of the highest ambient air organic concentration resulting from stack emissions.

The purpose of this memo is to present the results from the SCREEN 3 model, including the sensitivity analyses. This information was utilized to establish a basis for choosing the locations from which to collect ambient air samples that would show the highest ambient air organic concentrations.

2.0 MODEL PARAMETERS

The purpose of the modeling discussed in this memo is to determine the location of the predicted maximum ambient air organic concentrations resulting from remediation stack emissions. The model was not used to predict the actual concentrations. The actual concentrations will be determined by analyzing samples obtained from Summa canisters. It is important to note that the LOCATION of maximum predicted ambient air organic concentrations is not dependent on the actual emissions.

The SCREEN 3 model has a number of parameters, some of which are fixed, and some that must be supplied each time the model is run. This section discusses each parameter used in the SCREEN 3 model.

2.1 FIXED PARAMETERS

The model contains fixed parameters that are based on the building design, the facility location, and the design of the remediation stack. These parameters, and the basis for their selection, are provided in Attachment A.

2.2 VARIABLE PARAMETERS

The variable parameters that affect the modeling results are provided below:

- Ambient Temperature (° F)

- Exit Gas Temperature (° F)

- Flow Rate – cubic feet per minute (cfm)

- Meteorological Stability Class. Attachment B describes the atmosphere stability classes that must be used in the model.

  The USEPA has defined six atmospheric stability classes, identified as A through F. The stability classes, as shown in Attachment B, are dependent on the wind speed and the amount of incoming solar radiation (sunlight). The stability class is determined by measuring the wind speed and observing the amount of solar radiation. It should be noted, as will be shown later in this memo, that interpretation of the amount of solar radiation is not critical to the modeling results. For instance, if the wind speed was 9 miles per hour during the morning, a stability class of either B or C could be chosen. The results presented later in this memo show that choosing either B or C stability class has only a minor effect on the predicted location of the highest ambient organic air concentration.

3.0 MODELING RESULTS

3.1 PREDICTED LOCATION OF MAXIMUM AMBIENT AIR ORGANIC CONCENTRATIONS

When gases leave the stack at the remediation system, they rise above the top of the stack before they mix significantly with the air around the stack. This phenomenon is called the "plume rise." A plume rise is due to two effects, namely;

- Thermal. Hot air rises. If the gases exiting the remediation stack are hotter than the ambient air, they will rise above the top of the remediation stack simply due to their temperature.

- Momentum. The gases exiting the remediation stack have a vertical velocity caused by the SVE blowers. The greater the velocity, the higher the gases will rise. An analogy is throwing a baseball up in the air. A baseball thrown in the air with a high velocity will go higher than a baseball thrown with a low velocity.

The highest ambient air organic concentrations will result from minimal dispersion caused by a minimal plume rise. For instance, consider these two cases. The first case is an emission with no plume rise. The second case is an emission with a 1,000-foot plume rise. Clearly, the emissions that have a 1,000-foot plume rise will be dispersed over a much larger area than the emissions with no plume rise. Therefore, the maximum concentrations will occur with minimum plume rise.

In order to estimate the "worst-case" result (highest organic concentration at a receptor), conditions were selected to exclude the dispersion effects of thermal plume rise by choosing a common temperature for both the exit gas temperature and ambient temperature (75°F in this case). A flow rate of 1,400 cfm was chosen to minimize the dispersion effect due to momentum. This flow rate is the approximate minimum flow rate (and therefore minimum velocity) from the SVE system. When the ERH system is also operating, the flow rate increases. A higher flow rate (and velocity) results in a lower maximum ambient air concentration for the reasons discussed above.

Using the above organic assumptions, the stability class and location of the maximum predicted ambient air concentration is:

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Stability Class	Distance to Maximum Concentration (feet)
F	187

Therefore, the Screen 3 model predicts that the highest maximum ambient air organic concentration, resulting from stack emissions, will occur 187 feet downwind of the remediation system stack under the F stability class. The nearest property boundary to the remediation stack is located 212 feet to the east of the remediation stack. Therefore, the modeling shows that residential sampling should be conducted as close to the site perimeter as possible.

3.2 SENSITIVITY ANALYSES

As stated in Section 2.2, the modeling results are dependent on four parameters, namely, the ambient temperature, the exit gas temperature, the flow rate, and the meteorological stability class. The SCREEN 3 model does not allow use of exit gas temperatures less than the ambient temperature. Therefore, the only variables that can affect the modeling results are:

- Stability class
- Exit gas temperature
- Exit gas flow rate

Sensitivity analysis for each of the parameters was conducted, and the results are presented below.

3.2.1 Stability Class

The worst-case analyses presented above shows that the highest organic concentration will occur 187 feet from the remediation stack under meteorological stability class F. A series of runs were made to determine the distance to the maximum organic concentration under each of the other five stability classes. These results are presented below:

Stability Class	Distance to Maximum Concentration (feet)
A	138
B	197
C	259
D	220
E	220

The sensitivity analyses show that under any stability class, the location of the highest predicted ambient air organic concentration will occur between 138 feet and 259 feet downwind of the remediation stack.

3.2.2 Exit Gas Temperature

A greater plume rise will occur if the exit gas temperature is significantly higher than the ambient temperature, for the reason stated in Section 3.1. Therefore, a series of modeling runs were made under the assumption that the ambient temperature was 75° F, and the exit gas temperature was 100° F. The location of the highest organic concentration, and the corresponding stability class, are presented below:

Stability Class	Distance to Maximum Concentration (feet)
F	187

This result shows that the exit gas temperature has little or no effect on the location of the maximum predicted ambient air organic concentration. The result, 187 feet under F stability class, is the same as the "worst-case" scenario. In essence, an exit gas temperature 25° F higher than the ambient air temperature results in no significant thermal plume rise.

3.2.3 Exit Gas Flow Rate

A greater plume rise will occur if the exit gas flow rate (and therefore the exit gas velocity) is significantly higher than the assumed flow rate for the "worst-case," of 1,400 cfm. Therefore, a series of modeling runs were made under the assumption that the exit gas flow rate was 4,000 cfm, the expected maximum flow rate when the ERH system is operating. The location of the highest ambient air organic concentration, and the corresponding stability class, is presented below:

Stability Class	Distance to Maximum Concentration (feet)
D	220

This result shows that the increasing the exit gas flow rate increases the distance to the location of the predicted maximum ambient air concentration from 187 to 220 feet.

3.3 CONCLUSIONS

The location of the predicted maximum ambient air organic concentration is 187 feet downwind from the remediation stack. Sensitivity analyses of meteorological class, exit gas temperature, and exit gas flow rate show that the predicted range of locations exhibiting the highest ambient air organic concentration range from 138 feet to 259 feet. All the distances are within – or very close to – the facility boundary. Therefore, the modeling shows that residential sampling should be conducted as close to the facility perimeter as practical. The five locations selected for obtaining ambient air samples (RSML-1 through RSML-5) area as close to the facility's perimeter as practical.

ATTACHMENT A

MODEL FIXED PARAMETERS

- Dispersion coefficients. The model allows use of urban or rural dispersion coefficients. The model recommends rural coefficients for populations less than 21,200 people. Since the population within 1.5 kilometers is approximately 6,000 people (based on the 2000 census), rural coefficients were selected.
- Mixing Height. The regulatory default option is used.
- Fumigation. No fumigation is assumed.
- Property Line Distance. The distance to the closest property line is set at 212 feet.
- Anemometer height. The anemometer height is set at 10 meters, the model default value.
- Source Emission Rate. An arbitrary rate is assigned since the purpose of the modeling is to determine the LOCATION of maximum concentration, not the actual concentration. The actual concentration is determined from the Summa canisters.
- Stack Height. The stack height is fixed at 30 feet.
- Stack Inside Diameter. The inside stack diameter is fixed at 8 inches
- Receptor Locations. The model calculates concentrations from 20 to 2000 meters.
- Elevation. The receptor is assumed to be at 1.7 meters above the ground.
- Building Downwash. The downwash option was chosen since the stack is just 7 feet above the Lockformer building and, under this case, the guidance recommends the downwash option. The building height was set at 23 feet, the minimum horizontal distance was set at 305 feet, and the maximum building distance was set at 360 feet.

ATTACHMENT B

Stability Class Choices for Day and Nighttime (adapted from Turner 1994)

Surface Wind Speed		DAYTIME			NIGHTTIME*	
		Incoming Solar Radiation			Cloud Cover	
Miles per hour	Meters per second	Strong	Moderate	Slight	> 5/10	< 5/10
<4	<2	A	A-B	B	E	F
4 to 7	2 to 3	A-B	B	C	E	F
7 to 11	3 to 5	B	B-C	C	D	E
11 to 13	5 to 6	C	C-D	D	D	D
>13	>6	C	D	D	D	D

Choose D for completely overcast conditions during day or night.
* Nighttime is the period from 1 hour before sunset to 1 hour after sunrise.